

Chapter 7: Ionic Compounds and Metals

7.1 Ion Formation

I. Valence Electrons and Chemical Bonds

A. Chemical and physical properties depend on the amount of valence electrons of an atom

B. Chemical Bond - the force that holds two atoms together

1. Valence Electrons are involved with formation of chemical bonds

2. Chemical bonds can form by attraction between the positive nucleus of an atom and negative electrons of another atom or between positive and negative ions

II Positive Ion Formation - form when an atom loses one or more valence electrons

A. Cation - a positively charged ion

→ see Figure 2, p. 397 for Na^+ and Ne

1. Even though Na^+ loses an electron, ^{Explanation} (has same electron config. as Ne) Na^+ is not Neon (Na^+ still has 11 protons)

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B. Metal atoms are more reactive because they lose valence elec. easily

C. Transition metals generally form +2 or +3 ions

D. Pseudo-noble gas configurations - some elements in groups 11-14 lose electrons to form stable electron configurations

1. Ex: Zinc atom loses 2 electrons to get $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

III Negative Ion Formation

A. Anion - a negatively charged ion

1. Suffix -ide added to the ending of element when it becomes an anion

B. Nonmetals generally will gain electrons to obtain 8 valence electrons

1. However, P (phosphorus) can lose valence electrons

→ Figure 4, p. 399

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7.1 Review

Grade: 11th
Subject: Chemistry
Date: 1/14/13

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1 A positive ion forms when _____.

- ☒ A an atom loses one or more valence electrons
- ☐ B when an atom gains one or more valence electrons
- ☐ C electrons are pulled into the nucleus
- ☐ D electrons are pushed out of the nucleus

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2 Why is the Calcium ion (Ca^{2+}) more stable than the Calcium atom?

- A twenty electrons are more stable than eighteen electrons
- B eighteen electrons are less stable than twenty electrons
- C the two electrons more than the noble gas configuration is more stable
- ☒ D the noble gas configuration is more stable

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3 A positively charged ion is a anion.

True

False

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4 The number of protons remains unchanged during ion formation.

True

False

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5 Cations are associated with electron loss from an atom and Anions are associated with electron gain to an atom.

True

False

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6 When a ~~cation~~^{anion} is formed, the ending (suffix) -ide is added to the root name of the element.

True

False

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7.2 Ionic Bonds and Ionic Compounds

→ Main idea: Oppositely charged ions attract each other, forming electrically neutral ionic compounds

I. Formation of an Ionic Bond

A. Ionic bond - the electrostatic force that holds oppositely charged particles together in an ionic compound

1. compounds that contain ionic bonds = ionic compounds

a. Ionic compounds: Metals + O_2 = oxides;
other ionic compounds = salts

b. Binary ionic compounds contain metallic cation and nonmetallic anion (NaCl)

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2. For ionic bonds, the number of electrons lost and gained must be equal
 $Al^{3+} + O^{2-} = 2 Al^{3+} + 3 O^{2-} = Al_2O_3$

II Properties of Ionic Compounds

A. Physical structure - packed into regular repeating geometric patterns

1. Strong attractions between + and - ions result in crystal lattice

a. Crystal lattice - 3D geometric arrangement of particles

B. Physical properties

1. Melting pt., boiling pt., hardness, and electric conductivity, are all influenced by how strong particles are attracted to each other

2. Electrolyte - ionic compound whose aqueous solutions conducts electricity

III Energy and the Ionic Bond

A. Every chemical results in energy being absorbed or released

1. Energy absorbed = endothermic; releases energy = exothermic

2. Lattice energy - energy required to separate 1 mol of the ions of an ionic compound

a. greater the lattice energy, the greater the force of attraction between ions

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7.2 Review

Grade: 11th

Subject: Chemistry

Date: 1/16/13

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1 An ionic compound that will conduct an electric current when it forms an aqueous solution is a(n) _____.

- ☒ A electrolyte
- ☐ B nonelectrolyte
- ☐ C molecular compound
- ☐ D crystal lattice

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2 Ionic crystals have high melting points and high boiling points because _____.

- ☐ A ionic bonds are relatively weak
- ☐ B ionic solids are excellent conductors of electricity
- ☒ C ionic bonds are relatively strong
- ☐ D ionic liquids do not conduct electricity

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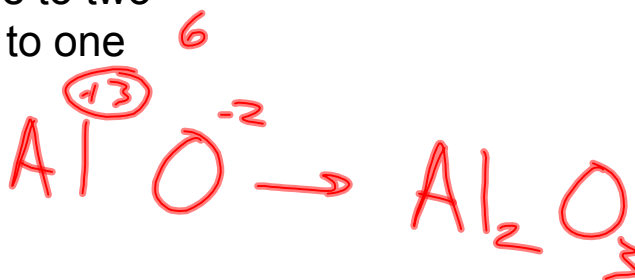
3 In the ionic solid compound (NaCl) there is a _____ ratio of sodium ions to chlorine ions.

- A two to one
- B one to two
- C two to two
- ☒ D one to one

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4 What is the ionic ratio of aluminum to oxygen in the ionic compound aluminum oxide ?

- A three to one
- B one to three
- ☒ C three to two
- D two to one



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- 5 The electrostatic force that holds oppositely charged particles together in a compound is the result of a(n) ionic bond.

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- 6 The energy required to separate 1 mol of the ions of an ionic compound is referred to as the ionic energy.

True

False

lattice

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- 7 A crystal lattice (two words) is a three-dimensional geometric arrangement of particles.

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7.3 Names and Formulas for Ionic Compounds

→ Main idea: in written names of ionic compounds, the cation always comes first than the anion

I. Formulas for ionic compounds

A. Formula Unit - chemical formula for an ionic compound; represents simplest ratio of ions involved

ex: $MgCl_2$ = ratio of 1 Mg to 2 Cl

B. Monoatomic ions - one atom ion: Mg^{2+} , Br^-

1. Binary ionic compounds - positive monoatomic ion and neg. monoatomic ion

C. Oxidation numbers - charge of the monoatomic ion is equal to oxidation number

1. Oxidation number of an element in an ionic compound equals to # of electrons transferred from the element to form the ion

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- E. Formulas for binary ionic compounds
1. cation is always written first, the anion
 2. subscript numbers = number of ions of each element in an ionic compound
- F. Polyatomic ions - ions made up of more than 1 atom
- Ex: NH_4^+ (see Table B, p. 421)

II. Names for Ions and Ionic Compounds

A. Oxyanion - polyatomic ion composed of an element, usually a nonmetal, bonded to one or more oxygen atoms

B. Naming Ionic Compounds

1. Name = Cation followed by anion
2. For monoatomic cations, use the element name
3. For monoatomic anions, use the root of the element name, plus suffix -ide
4. If cation has more than one oxidation (Fe), then write oxidation in Roman numerals in parentheses after the name of the cation

→ Common for transition metals

Ex: Fe^{+2} and O^{2-} Fe_2O_3
iron (II) oxide

Ex: Fe^{+3} and O^{2-} Fe_2O_3
Iron (III) oxide

Ti^{+3} O^{2-}

Ti_2O_3

titanium (III) oxide

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7.3 Review

Grade: 11th
Subject: Chemistry
Date: 1/17/13

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1 A polyatomic ion is a one-atom ion.

True

False

more than 1

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- 2 A oxyanion is a polyatomic ion composed of an element, usually a nonmetal, bonded to one or more oxygen atoms.

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- 3 The name of the following compound, NaBr, is ...

sodium bromide

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4 The name of the following compound, KOH, is....

potassium hydroxide

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5 The chemical formula for an ionic compound, called a formula unit, represents the simplest ratio of the ions involved.

True

False

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7.4 Review

Grade: 11th
Subject: Chemistry
Date: 1/22/12

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1 Which of the following is a correct description of a metallic property?

- A metals are brittle
- B metals have a dull appearance
- C metals gain electrons to form anions
- D metals are malleable

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2 Which of the following metallic properties is best explained by the "sea of electrons" model of metals?

- A density
- B electrical conductivity
- C atomic mass
- D ionic charge

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3 Sterling silver is known as a substitutional alloy because _____.

- A copper atoms replace some of the silver atoms in the metallic crystal
- B smaller copper atoms fill in holes in the silver metallic crystal
- C copper is less dense than silver
- D copper is less expensive than silver

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4 Electrons in the "electron sea" are known as _____ electrons.

- A valence
- B delocalized
- C negative
- D metallic

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5 A mixture of elements that has metallic properties is a(n)
alloy.

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6 Metals are ^{ductile} durable, which means that they can be rolled into a wire.

True

False

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Chapter 7 Review

Grade: 11th
Subject: Chemistry
Date: 1/28/13

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- 1 Positive and negative ions form because an atom gains or loses electrons to achieve a stable electron configuration.

True
False

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2 How many valence electrons does cesium have?

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3 How many valence electrons does rubidium have?

Jan 27-4:14 PM

4 How many valence electrons does gallium have?

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5 How many valence electrons does strontium have?

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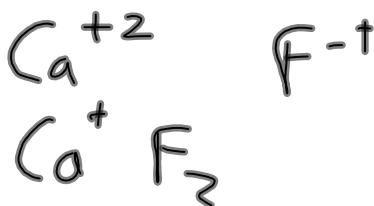
6 What is the cation to anion ratio for potassium chloride?
(# of + to # of -) In other words what is the ratio of the
number of molecules of cations to the number of
molecules of anions?

- A 1:1
- B 1:2
- C 2:1
- D 2:2

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7 What is the cation to anion ratio for calcium fluoride?

- A 1:1
- B 1:2
- C 2:1
- D 2:2



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8 What is the cation to anion ratio for calcium oxide?

- A 1:1
- B 1:2
- C 2:1
- D 2:2



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9 What is the cation to anion ratio for strontium chloride?

- A 1:1
- B 1:2
- C 2:1
- D 2:2

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10 Ionic compounds will conduct electric current in the molten state or when dissolved but are nonconducting solids at room temperature.

True

False

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11 Which has a greater lattice energy, CsCl or KCl?

A KCl
B CsCl



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12 Which has a greater lattice energy, K_2O or CaO ?

- A K_2O (K_2O)
B CaO



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13 Name the following compound



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14 Name the following compound



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15 Name the following compound



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16 Name the following compound



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17 Name the following compound



Jan 27-4:31 PM

18 Each positive ions are attracted to delocalized valence electrons in a _____ bond.

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19 In a substitutional alloy, metal atoms are similar in size.

True

False

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20 In a interstitial alloy, there are two differently sized metal atoms.

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21 You are given a liquid of unknown density. The mass of a graduated cylinder containing 2.00 mL of the liquid is 34.68 g. The mass of the empty graduated cylinder is 30.00 g. What is the density of the liquid (answer in g/mL)?

$$34.68\text{g} - 30.00\text{g} = \frac{4.68\text{g}}{2\text{mL}} = 2.34$$

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- 22 In the laboratory, students used a balance and a graduated cylinder to determine that the sample has a mass of 19.21 g, the volume by itself in the graduated cylinder is 39.0 mL, and that the volume of the water plus the sample is 43.1 mL. If the accepted value for the sample's density is 7.01 g/mL, what is the percent error of the students' observed data (answer in %)?

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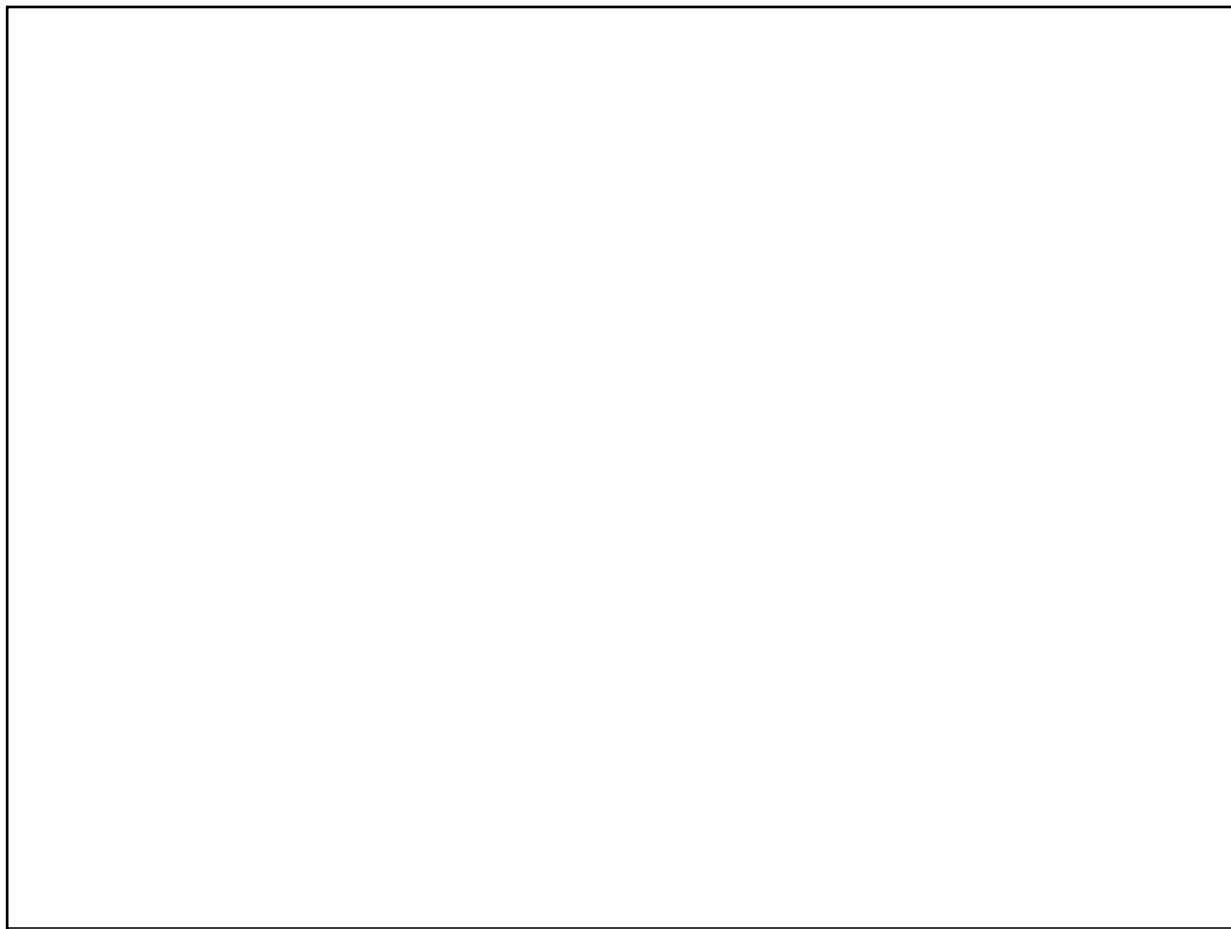
Paper Requirements

- * 5pts 1-2 pg double spaced, size 12 font, times new roman
- * 3pts 2 sources; include sources in reference section (3rd page)
- * tell us the story/history of an ionic compound or a metal alloy
- 2pts → chemical formula (NaCl)
- 2pts → written compound's name sodium chloride
- 3pts → when it was first created or found and by whom
- 5pts → what is its everyday use

20 pts

due Fri

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